normal working temperatures are employed, special "quick-finish" (rapid access) films have to be used which stand temperatures up to say approximately 200°F. (93°C.).

Some of the machines described in the foregoing use "monobaths", i.e. Table LVIII.

In cases where the two solution technique is used, a fixing formula based on ammonium thiosulphate should be chosen. For certain specific uses, however, where permanence of the photographic record is of less importance and where it is desirable to produce it in the least possible time, the so-called "stabilisation technique" is applied. This is based on the use of a stabiliser which renders the undeveloped silver halide relatively inert to the effects of heat, light and moisture. The main stabilising agents used for this purpose are: Ammonium thiocyanate and thiourea ammonium thiocyanate approximately 20% solution, thiourea in about 3% solution. Prints stabilised in this way are not to be washed (see page 296).

After Treatment of the Negative

The correcting of negatives by after treatment, in particular by reducing or by intensification, has lost much of its former importance. This is mainly because a satisfactory print can be made from almost any negative on one or other of the many grades of paper now available. Moreover, the very notable latitude in exposure and in manipulation of modern negative material makes the really poor negative a comparative rarity.

Hence the correction of a negative by chemical treatment is called for only in exceptional cases, or when the negative has to be suited to some special positive material which is only available in a restricted range of contrasts. A particular case which may arise is the preparation of lantern slides or diapositives, for here the material available does not appear in a wide range of contrasts.

REDUCTION

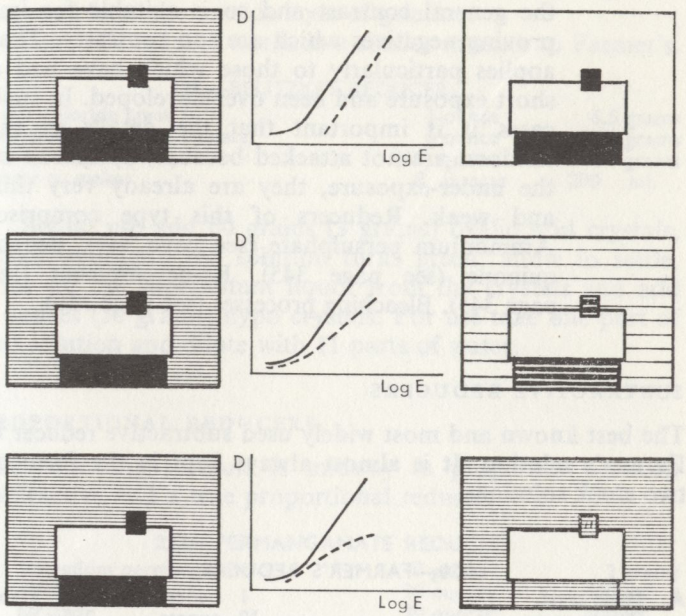
All reducers are oxidising solutions, they either oxidise the silver to a soluble salt or contain a solvent for the silver salts if these are insoluble in water. The permanganate, dichromate, ferric ammonium sulphate, ceric and persulphate reducers are used in the presence of sulphuric acid, forming silver sulphate which is soluble in water. Ferricyanide is used with hypo or thiocyanate to dissolve the silver ferrocyanide which is formed but not soluble in water.

The object of reduction is, as its name implies, the reducing of the density of a negative; it may be the correcting of over-exposure or over-development. Errors in exposure or development may display themselves in various ways in the negative and variously affect its character. The choice of the right reducing agent to use in any particular case will go

far to bring about the necessary correction. The way in which various reducers act is shown on page 341, where the gradation of various negatives is shown diagrammatically in the form of a stairway of densities. They give a section through the film of the negative showing the three steps of varying heights representing shadows, middle tones and highlights. The various reducers can act in three different ways which we will now describe.

(1) The reducer removes the same quantity of deposit from shadows, middle tones and highlights. It planes down the surface of the negative deposit evenly (page 341), and to this type of reducer we give the name subtractive. As the diagram shows the greatest effect is in the shadows, less in the middle tones and least of all in the highlights. Hence the general effect is to increase the general contrast of the negative. Reducers of this type are Farmer's (see page 342) and Belitzki's (see page 343). They are particularly adapted for reducing negatives where the shadows want clearing and where a general increase in contrast is desirable, as is particularly the case with over-exposed negatives.

(2) The reducer acts proportionally to the amount of silver present, that is it removes but little from the thin parts, more from the middle tones and most in the heavy densities (see page 341). From the diagram it will be seen that the action results in a notable reduction in the density of the whole negative, the total density of which may be reduced to about one half. It might be said to represent the opposite of over-exposure where, as we have seen (see page 34), increasing length of development gives increased density without notably increasing the contrast of the negative. Reducers of this type are called proportional, and the best known examples are potassium permanganate (see page 343), and mixtures of permanganate and ammonium persulphate (see page 343). These proportional reducers are used to correct over-developed negatives, or all those in which the densities are too heavy.



Reduction consists of reducing the density of the negative. Reducers can act in several ways, as the diagram shows. The middle series shows the effect of three types of reducer on the sensitometric curves. The solid lines represent the negative before reduction and the dotted lines represent the negative after reduction. The diagrammatic representation of the house shows the effect of reduction. On the left, the negative before treatment and on the right, after reduction. From top to bottom: First, subtractive reduction. Second, proportional reduction. Third, super-proportional reduction.

(3) The reducer attacks the heavy parts of the negative more strongly than the middle tones and lighter parts (see page 341). It is called super-proportional for it tends towards a reduction of the general contrast and so is suitable for improving negatives which are too contrasty. That applies particularly to those which have had a short exposure and been over-developed. In such cases it is important that the details in the shadows are not attacked because, by reason of the under-exposure, they are already very thin and weak. Reducers of this type comprise: Ammonium persulphate (see page 344). Benzoquinone (see page 345). Re-development (see page 345). Bleaching processes (see page 346).

SUBTRACTIVE REDUCERS

The best known and most widely used subtractive reducer is Farmer's solution. It is almost always kept in the form of two stock solutions.

220.—FARMER'S REDUCER

A.	Hypo cryst.	1 ounce	25 grams
	Water up to	10 ounces	250 ml.
B.	Potassium ferricyanide	½ ounce	12.5 grams
	Water up to	5 ounces	125 ml.

Immediately before use take 4 ounces (100 ml.) water, 4 ounces (100 ml.) of solution A and 2 drams (6 ml.) solution B and mix well. The action of the reducer depends upon the proportion of solution B, the more B is present the more rapid the action, but the strength given above is convenient for good control of the process.

Caution: The stock solutions keep indefinitely, the mixed solution has very little keeping power.

The reducing should be watched carefully. It is best to treat the negative for about 20 seconds in the reducer, then rinse well and examine, repeating the operation until the required reduction has been reached. Reduction can be undertaken immediately after the negative has been fixed,

only a short wash being necessary before placing the negative in the reducing bath. When reduction is complete the negative is well washed and dried. Such reduced negatives always show a shiny surface due to the silver having been removed from the outside layer of gelatine.

Belitzki's reducer works in a similar manner to Farmer's.

221.—BELITZKI'S REDUCER

Ferric chloride cryst.	¼ ounce	6.5 grams
Potassium or sodium oxalate	½ ounce	12.5 grams
Sodium sulphite anhyd.	160 grains	8 grams
Water to make	8 ounces	200 ml.

Before use add 60 grains (3 grams) oxalic acid crystals, shake well until the solution turns green, allow to settle, pour off the supernatant liquor from the crystals and add 2 ounces (50 grams) hypo crystals. For use take one part of this solution and dilute with 11 parts of water.

PROPORTIONAL REDUCERS

The following formula is midway in properties between subtractive and a true proportional reducer.

222.—PERMANGANATE REDUCER

A.	Potassium permanganate	40 grains	2 grams
	Water to make	20 ounces	500 ml.
B.	Water	20 ounces	500 ml.
	Sulphuric acid conc.	20 minims	1 ml.

Immediately before use take 4 ounces (100 ml.) of water and add 2 drams (7 ml.) each of A and B.

To produce a correctly proportional reducer potassium permanganate is combined with ammonium persulphate as follows:

223.—PERMANGANATE-PERSULPHATE REDUCER

A.	Potassium permanganate, 1% solution	½ ounce	12.5 ml.
	Sulphuric acid, 10% solution	¼ ounce	6.5 ml.
	Water to make	20 ounces	500 ml.
B.	Ammonium persulphate	½ ounce	12.5 grams
	Water to make	20 ounces	500 ml.

For use take 1 part A, 1 part B and 4 parts of water.

If in either of the above cases the negative shows a brown stain after reduction, this can be removed by immersion in the following:

224.—STAIN REMOVER

Sodium sulphite anhyd.	6 ounces	150 grams
Oxalic acid	1 ounce	25 grams
Water to make	40 ounces	1000 ml.

SUPER-PROPORTIONAL REDUCERS

The property of reducing the denser parts of the negative in preference to the middle tones and shadows is possessed in an unusual degree by the ammonium persulphate reducer. Ammonium persulphate is, however, notably subject to deterioration on keeping and is also easily affected by other substances; hence successful control of reduction when using it requires special precautions. The usual solution used consists of:

225.—AMMONIUM PERSULPHATE REDUCER

Ammonium persulphate	50 grains	2.5 gram
Sulphuric acid, 10% solution	20 minims	1 ml.
Water	4 ounces	100 ml.

If the tap water contains chloride or lime salts distilled water should be used. Also when fresh the crystals of persulphate crackle as they dissolve; if this does not occur the freshness of the persulphate is suspect and the action of the reducer will be lessened or may be absent.

Some workers prefer as an alternative solution the following:

226.—ALTERNATIVE AMMONIUM PERSULPHATE REDUCER

Distilled water	4 ounces	100 ml.
Ammonium persulphate	50 grains	2.5 grams
Ammonia 0.910	40 minims	2 ml.
Hypo	50 grains	2.5 grams

All negatives that are to be reduced with persulphate must be very thoroughly washed. The negative must be carefully watched during the process of reduction, preferably at intervals of not more than 15 seconds. The rate of reduction varies with different materials; with some it is slow, with others very rapid. As soon as the desired degree of reduction is approached the process should be stopped. This can best be done by using a stop-bath consisting of a 12% solution of sodium sulphite.

224.—STAIN REMOVER

Sodium sulphite anhyd.	6 ounces	150 grams
Oxalic acid	1 ounce	25 grams
Water to make	40 ounces	1000 ml.

SUPER-PROPORTIONAL REDUCERS

The property of reducing the denser parts of the negative in preference to the middle tones and shadows is possessed in an unusual degree by the ammonium persulphate reducer. Ammonium persulphate is, however, notably subject to deterioration on keeping and is also easily affected by other substances; hence successful control of reduction when using it requires special precautions. The usual solution used consists of:

225.—AMMONIUM PERSULPHATE REDUCER

Ammonium persulphate	50 grains	2.5 gram
Sulphuric acid, 10% solution	20 minims	1 ml.
Water	4 ounces	100 ml.

If the tap water contains chloride or lime salts distilled water should be used. Also when fresh the crystals of persulphate crackle as they dissolve; if this does not occur the freshness of the persulphate is suspect and the action of the reducer will be lessened or may be absent.

Some workers prefer as an alternative solution the following:

226.—ALTERNATIVE AMMONIUM PERSULPHATE REDUCER

Distilled water	4 ounces	100 ml.
Ammonium persulphate	50 grains	2.5 grams
Ammonia 0.910	40 minims	2 ml.
Hypo	50 grains	2.5 grams

All negatives that are to be reduced with persulphate must be very thoroughly washed. The negative must be carefully watched during the process of reduction, preferably at intervals of not more than 15 seconds. The rate of reduction varies with different materials; with some it is slow, with others very rapid. As soon as the desired degree of reduction is approached the process should be stopped. This can best be done by using a stop-bath consisting of a 12% solution of sodium sulphite.

The negative is given a rinse and placed in this bath for a minute or so and then given a thorough final wash.

Most of the earlier failures with persulphate reducers can be traced to the use of old and partially decomposed, or to impure persulphate. They had the effect, however, of inducing workers to use other methods which were less unreliable. Of these one well used formula is that using benzoquinone.

227.—BENZOQUINONE REDUCER

Water	4 ounces	1000 ml.
Sulphuric acid conc.	60 minims	3 ml.
Benzoquinone	20 grains	1 gram

The well washed negative is treated for 4-5 minutes in this solution.

RE-DEVELOPMENT

A useful and controllable method of reducing the contrast of a hard negative is the so-called re-development method in which the negative is just bleached in a suitable bleaching bath and is then re-developed to the desired contrast and density. This is sometimes called harmonising.

What actually happens is that during the so-called bleaching process the developed silver image of the negative is re-converted into chloride or bromide and so can be developed again to the desired gradation and density. For this purpose it is preferable to use a somewhat slow working fine-grain developer; as soon as the required density and gradation are reached the re-developed negative is thoroughly fixed out.

A useful bleaching solution is:

228.—BLEACH BATH FOR RE-DEVELOPMENT

Water	40 ounces	1000 ml.
Copper sulphate	4 ounces	100 grams
Sodium chloride (common salt)	4 ounces	100 grams
Sulphuric acid conc.	1 ounce	25 ml.

Bleaching must be thorough and no trace of the original reduced silver image must remain. When this is accomplished, wash for a few minutes until the image is pure white and re-develop with the following developer.

229.—FINE-GRAIN RE-DEVELOPER

Water	40 ounces	1000 ml.
p-Phenylenediamine	60 grains	3 grams
Sodium sulphite anhyd	1 ounce	25 grams

Development must be carried out until the image is plainly seen through the back of the negative otherwise the gradation will suffer and the negative be too thin. Another developer, somewhat more energetic, which can be used for this purpose is the metol single solution (Nos. 1-3) used well diluted. As a general guide the re-developed negative should appear not very different to the original negative before bleaching. If it is now rinsed and thoroughly fixed it will be found to have distinctly less density and a less steep gradation.

Another interesting method of varying and reducing the contrast makes use of the idea of protecting the silver in the shadows or thin densities of the negative either by depositing there a substance not attacked by the reducer or by converting the silver into a compound which equally is not attacked. To do this the negative is given a superficial bleach in the following bath:

230.—BLEACH BATH FOR SUPER-PROPORTIONAL REDUCING

Water	4 ounces	100 ml.
Mercuric chloride	40 grains	2 grams
Potassium bromide	40 grains	2 grams

The time of the bleaching is so arranged that only in the shadows and the thinner middle tones does bleaching take place. Hence when seen through the back of the negative all the parts that are to be reduced must remain black.

Then the negative is washed well and treated in a

231.—GOLD CHLORIDE BATH
Solution of gold chloride 1 : 500

This will have the effect of darkening all the bleached parts and as soon as this happens the bathing is stopped. The negative is now washed and treated with Farmer's reducer until the heavy densities are reduced as required.

With experience this is a very practical and useful method and can provide almost any desired alteration of contrast.

Variations of the method consist in the use of gold or selenium toning of the image, omitting the bleaching bath; in this way the toned parts are protected from the action of the reducer. The bleaching method is, however, safer and allows of better control as the observation of the image during

the bleaching is a certain guide to the progress of the operation. In the gold and selenium toning there is no alteration in image colour, hence there is no observable change to act as a guide to the completeness or otherwise of the reaction.

INTENSIFICATION

Negatives which are too soft and thin, either through overexposure, too short development or other mistakes can be improved by intensification. This is called for when it is not possible to produce a satisfactory print by the choice of a suitable hard gradation paper.

There are physical, chemical and optical intensifiers. Chemical intensification is effected by adding something to the silver image—either silver or other compounds. If, for instance, the image is bleached i.e. converted into silver chloride with a solution of ferricyanide and sodium chloride and then redeveloped in a non-staining developer, a moderate increase in density can be achieved. If we use a staining developer, such as pyrogallol, a brown-black image is obtained which has a higher printing density than a neutral black image, provided the positive material is not colour sensitive. This process is called optical intensification, as it depends on the colour of the transmitted light rather than on its intensity. We talk of physical intensification if metallic silver or mercury is deposited on the silver image with the help of a reducing agent in the solution, the silver grains acting as neutral nuclei for this reaction. A suitable solution consists for instance, of silver nitrate, pyrogallol and citric acid, or a mercury salt, metol and citric acid.

Intensifying consists in depositing either metal or a metallic compound of black or dark colour on the silver forming the negative image and so increasing its printing density.

There is one reservation to be made here, and that is the fact that some enlarging papers today are orthochromatic and some panchromatic.* With such papers a negative having a yellow-brown image such as results from uranium intensification will not give the same result as on a normal, not colour sensitised bromide paper. Hence care should be used in the choice of the method of intensification.

*See Enlarging, by C. I. Jacobson and L. A. Mannheim, Focal Press.

In the following formulae the different types of intensifier are separated according to the degree of density and contrast they can confer on the negative. With the range of printing and enlarging papers available today it will generally be found convenient to use an intensifier of medium type, e.g., mercury, chromium or dyestuff.

It must be emphasised that one can only intensify when there is some image to work on. If under-exposure has been so gross that no image has been developed in the shadows and only clear film exists, then there is nothing to intensify and no use in attempting it.

The action of intensifiers on the negative image is shown on page 349. It will be seen that with almost all intensifiers the denser parts of the image are more strongly intensified than the shadow details, hence the contrast is increased. These are just the properties required, for in the majority of cases our reason for intensifying a negative is to increase density and also to obtain greater contrast.

MERCURY INTENSIFIER

This is the most widely used method. The negative must be thoroughly fixed and washed before intensification is attempted. Any trace of hypo left in the negative will cause indelible stains to appear.

The negative is first bleached in the following solution:

232.—BLEACH BATH FOR MERCURY INTENSIFICATION

Mercuric chloride	40 grains	2 grams
Ammonium chloride	40 grains	2 grams
Water	4 ounces	100 ml.

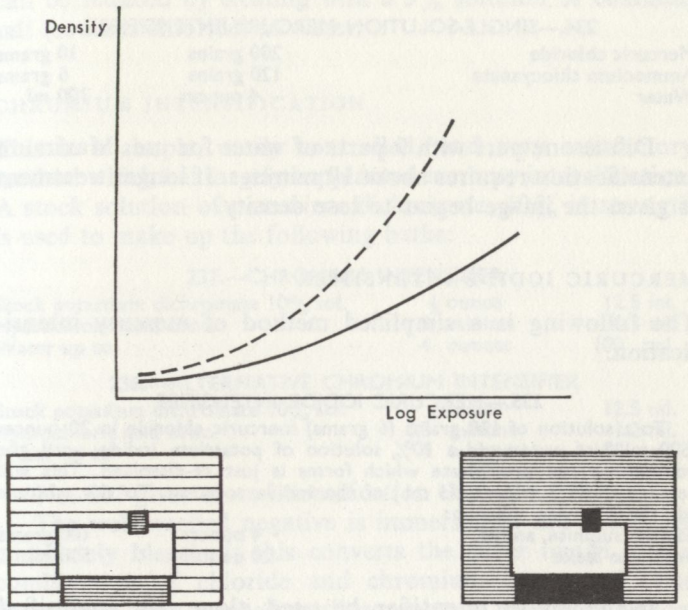
Bleaching must be carried on until all trace of the black silver image has been replaced by a grey-white image.

Blackening is carried out after the bleached negative has been given a short wash and may be done with:

233.—BLACKENING BATH FOR MERCURY INTENSIFICATION

(1) A 10% solution of sodium sulphite or
(2) A 5% solution of ammonia or
(3) By using any normal (not fine-grain) developer

Of the three the first gives the least effect and the third



Intensification of a weak negative consists in increasing its density by the addition of a black or a dark-coloured layer through chemical action. The additional density is proportionate to the densities already existing in the weak negative. The deep shadows remain virtually unaltered as almost clear emulsion while the highlights attract the greatest proportion of the additional intensity. In this way the contrast of the negative can be increased. The upper part of the diagram shows the effect of intensification on the characteristic curve (full line before intensification and dotted line after intensification). The lower stylised picture shows the effect of the increased contrast.

the most. The second gives an image which does not withstand prolonged light action.

After blackening the negative should be well washed.

A single solution mercury intensifier can be made up:

234.—SINGLE-SOLUTION MERCURY INTENSIFIER

Mercuric chloride	200 grains	10 grams
Ammonium thiocyanate	120 grains	6 grams
Water	4 ounces	100 ml.

Dilute one part with 9 parts of water for use. Maximum intensification requires about 10 minutes. If longer treatment is given the image begins to lose density.

MERCURIC IODIDE INTENSIFIER

The following is a simplified method of mercury intensification.

235.—MERCURIC IODIDE INTENSIFIER

To a solution of 120 grains (6 grams) mercuric chloride in 20 ounces (500 ml.) of water add a 10% solution of potassium iodide until the voluminous red precipitate which forms is just re-dissolved. This will require about 3 ounces (75 ml.) of the iodide solution. To the mixture add the following solution:

Sodium sulphite, anhyd.	4 ounces	100 grams
Water to make	20 ounces	500 ml.

If the above intensifier be used alone, the intensified negative has poor keeping properties, it is therefore usual to blacken the image by using any normal developer.

URANIUM INTENSIFIER

This method gives strong intensification but the image colour is yellow brown and the keeping properties of the intensified image are not good.

236.—URANIUM INTENSIFIER

A.	Water	4 ounces	100 ml.
	Uranium nitrate	20 grains	1 gram
	Acetic acid glacial	½ ounce	12.5 ml.
B.	Water	4 ounces	100 ml.
	Potassium ferricyanide	20 grains	1 gram

For use take one part of A and two parts of B, mix, and then intensify to the required degree. Care must be exercised

in washing the intensified negative, using running water and wash until the water runs smoothly over the intensified surface. If washing be prolonged the density tends to regress. If the yellowish colour of the highlights is objectionable, it can be reduced by treating with a 5% solution of common salt (sodium chloride) in water.

CHROMIUM INTENSIFICATION

This is a simple, easily controlled, and very satisfactory method which has largely supplanted mercury intensification. A stock solution of potassium dichromate, 10% in strength is used to make up the following baths:

237.—CHROMIUM INTENSIFIER

Stock potassium dichromate 10% sol.	½ ounce	12.5 ml.
Hydrochloric acid conc.	5 minims	0.3 ml.
Water up to	4 ounces	100 ml.

238.—ALTERNATIVE CHROMIUM INTENSIFIER

Stock potassium dichromate 10% sol.	½ ounce	12.5 ml.
Hydrochloric acid conc.	25 minims	1.2 ml.
Water up to	4 ounces	100 ml.

No. 237 gives more intensification than No. 238.

The well washed negative is immersed in the bath until completely bleached; this converts the silver image into a combination of chloride and chromium compound. The negative is now washed until completely free from yellow stain, and developed in daylight, or after exposure to daylight, with a normal developer.

A notable advantage of the method is that if sufficient intensification is not attained in the first attempt the whole treatment can be repeated.

COPPER-SILVER INTENSIFIER

For very weak negatives M. G. Zelger recommends the following formula:

239.—COPPER-SILVER INTENSIFIER

A.	Water	20 ounces	500 ml.
	Copper sulphate	100 grains	5 grams
	Acetic acid glacial	1 ounce	25 ml.
B.	Water	10 ounces	250 ml.
	Potassium iodide	100 grains	5 grams
	Ammonia 880	2 ounces	50 ml.

Two parts of A and one part of B are mixed to form the bleach bath; the negative after bleaching is washed for 15 minutes and blackened in

240.—BLACKENING BATH FOR COPPER-SILVER INTENSIFIER

Water	10 ounces	250 ml.
Silver nitrate	20 grains	1 gram
Sodium acetate	80 grains	4 grams

If desired the film may be hardened after the bleach bath in saturated solution of potash alum.

QUINONE-THIOSULPHATE INTENSIFIER

In many cases with high speed photography it is impossible to give adequate exposure. In such cases considerable intensification is the only solution of the problem of getting a printable negative. Sports photographers in particular are always faced with difficulties of this kind, and similar problems are also found in stage and circus photography where the light is poor but reasonably fast shutter speeds are still needed.

Good results are being obtained with the Kodak IN6 quinone-thiosulphate intensifier formula. This is of special value when used on high-speed material, producing a greater effect than any single-solution intensifier.

The intensified image is brownish, and is not indefinitely permanent, being similar in this respect to uranium-toned images. Negatives must be well washed and free from finger marks, and require a preliminary treatment in alkaline formaldehyde hardener, such as Formula 307 on page 396.

241.—KODAK IN6 QUINONE-THIOSULPHATE INTENSIFIER

A.	Warm distilled water	60 ounces	750 ml.
	Sulphuric acid conc.	2 ounces 96 minims	30 ml.
	Potassium dichromate	1 ounce 350 grains	22.5 grams
	Distilled water to make	80 ounces	1000 ml.
B.	Warm distilled water	60 ounces	750 ml.
	Sodium bisulphite	133 grains	3.8 grams
	Hydroquinone	1 ounce 88 grains	15 grams
	Kodak Wetting Agent, 10% solution	1 ounce 270 minims	20 ml.
	Distilled water to make	80 ounces	1000 ml.
C.	Warm distilled water	60 ounces	750 ml.
	Sodium thiosulphate cryst.	1 ounce 350 grains	22.5 grams
	Distilled water to make	80 ounces	1000 ml.

The sulphuric acid must be slowly stirred in.

Distilled water should be used, as a trace of chlorides in the water will greatly reduce the degree of intensification, and may bleach the image.

For use one part of solution A is taken, and two parts of B stirred in, followed by two parts of C. The mixture is well stirred, and another part of solution A is then added. This order of mixing is important, and should not be changed.

After a five minute wash the negatives are hardened by immersing them for about five minutes in the alkaline formaldehyde hardener (No. 307, page 396), and washed again for five minutes in running water. They are then treated in the working solution, made up as described above, for up to ten minutes with continuous agitation. Negatives are best treated singly. They are then well washed, and dried. The working solution should only be made up immediately before it is needed and must be discarded after use.

The brown colour of the image is really an intentional developer stain and is of the same nature as the stain produced on prints when they are put into a fixing bath after development without an intermediate rinse.

The intensified image is destroyed by acid hypo, so intensified negatives must not be placed in fixing solutions, or in washing water contaminated by fixing baths.

The illustrations of defects in negatives on pages 321-336 have been contributed by the *Eastman Kodak Company*, Rochester (U.S.A.), the *Gevaert Factories*, Antwerp (Belgium) and *Ilford Limited*, London.

Retouching

The retouching of negatives today is usually confined to dealing with actual imperfections in the negative or to modifying some excess or want which detracts from the quality of the picture. In earlier days retouching reached such proportions that it was not uncommon to find the finished picture bearing but little resemblance to the original. Such "beautifying" is not the true object of retouching.

PLAN OF WORK

If retouching is undertaken it should always be carried out in a definite order and according to a deliberate plan.

(1) The first stage is the wet retouch sometimes called chemical retouching. This comprises the local or partial reduction or intensification of any areas requiring such treatment.
(2) The treatment of the dried negative comprises dealing with those portions which are too thin and which require blocking out or treating in such a manner as to reduce the amount of light which they can pass.
(3) If any slip be made in carrying out No. 2, then the matter can usually be remedied by treatment or washing of the negative.
(4) The next process will be the mechanical reduction of any part of the negative which is too dense, i.e., rubbing down.
(5) Then will follow, if required, any knife-work, which is used to reduce small local densities, to remove black spots and the like.
(6) The last retouching to be undertaken is that

carried out with the pencil, and then it is usual to varnish the negative.

This long list does not mean that all or even any of these stages are necessary for every negative. It does mean that if more than one of the operations is required they should follow one another in an ordered sequence so that they do not interfere with one another.

PARTIAL REDUCTION OR INTENSIFICATION

In normal reduction and intensification the whole of the negative image is treated, whereas in chemical retouching only certain parts of the image are singled out, as for example in a landscape it may be found that the sky is too dense and hence would print too light.

To partially reduce this portion of the negative the procedure is as follows.

Soak the negative for about 10 minutes to swell the gelatine, and then place it on a white tile, or in a white dish. Take a paint brush, not too full, of Farmer's reducer (see page 342), and distribute the Farmer's reducer carefully over the sky to be reduced. The line where the sky meets the rest of the picture must be carefully traced and not overstepped. Care must be taken not to flood the reducer over the negative. After a fewmoments the negative should be well rinsed and examined to ensure that action is equal over the desired area. This should be repeated until the necessary amount of reduction has been achieved.

Where very small areas in the negative call for reduction the same procedure can be followed, but a fine camel hair brush should be used to apply the reducing solution. A useful tip is to thicken the reducer with glycerine so that it does not flow so easily and can be more easily confined to the necessary limits.

In special cases those parts of the negative which are not to be reduced may be protected by painting with a waterproof varnish such as shellac. This should be applied, of course, to the dry negative. When the varnish is dry the negative can be treated after swelling in a reducer bath, washed and dried and the protective varnish then removed with benzol or alcohol.

Partial intensification can be carried out by similar means,

using the various intensifiers that are normally used (see page 347).

SHADING AND BLOCKING OUT

This is used for those parts of a negative where the image is so thin that it will print too dark, and where local intensification is not possible, or unlikely to give the desired result.

Solutions of red or yellow dyestuffs are used which tint the gelatine of the negative and so retard the passage of light. Such substances are Neo-Coccin, Vanguard yellow, etc.

The art consists in tinting the required part of the negative perfectly evenly. To this end a very pale solution is used to begin with; the brush is well filled and applied firmly and evenly to the negative so that the whole area to be treated is flooded evenly with the dye solution.

With films the dye may be applied to the back of the film, when as in many cases, this carries a gelatine coat. It is not possible to use this method with unbacked 35 mm. (miniature) film for miniature cameras. With glass plates the dye is sometimes applied to the back but causes trouble when enlargements have to be made. When it is desired to use the back of the plate it must first be given a coat of varnish which can be prepared as follows:

242.—MATT VARNISH

Ether	7 ounces	175 ml.
Gum sandarac	¾ ounce	18 grams
Gum mastic	80 grains	4 grams
Benzol	3 ounces	75 ml.

If the ether is quite water free, about 20 minims (1.5 ml.) of water should be added so as to ensure that the varnish will dry with a matt surface.

For dealing with quite small areas which require darkening, fine graphite powder can be used, rubbing it into the matt varnish coating with a leather stumping pencil.

Where there are parts that require a little lightening in cases where the plate has been given a matt-varnished back, the varnish can be removed by a knife or by an alcohol damped stump.

In some cases it is necessary to cut out portions of a negative so that they do not print at all. This is usually the

case with unwanted backgrounds, and the usual method is to use an opaque medium, such as Photopake, which is painted either on the face, or more usually on the back of the negative and so cuts out that part of the negative it covers.

Another method is to use the matt varnish and tint it strongly with a red, yellow or other dye so that no actinic light can pass. Such dyes as congo red, quinoline yellow, malachite green, etc., are used for this purpose, but the process is only suitable for use with glass negatives from which contact copies are required.

SPOTTING

Spotting is the name given to the operation of removing or filling in small spots, flecks or pin holes in the negative. The procedure naturally depends on the nature of the spot.

Whatever the type of spot the aim is to treat it so that it is hidden, hence if it be a pin hole in a light part of the negative, it is spotted out by using special water-colour paint and a very fine pointed brush. The first step is to ensure that the tint used is the same shade as that part of the negative where the spot occurs. This is achieved by a trial or two on a piece of white paper. Then the spot or pin hole is carefully touched with the point of the brush, laden with the retouching medium, until the required density is built up. Photopake is sometimes used, but the water colour retouching medium is preferable as Photopake on a thinly covered part of the negative tends to give a light coloured spot or area on prints.

Some workers prefer to do their retouching on the print and not on the negative, but it is obvious that if many prints are to be made the retouching should take place on the negative before printing.

DRY REDUCTION

Reducing normally depends upon chemical action, that is the solution of part of the silver image, but local reduction can be carried out by mechanical means, that is by rubbing down or abrading the heavier parts of the image. Globe metal polish has long been used for this purpose, but if unobtainable a substitute may be prepared as follows:

243.—DRY REDUCER

Paraffin wax	1 ounce	25 grams
Tallow	1½ ounces	36 grams
Vaseline	4 ounces	100 grams
Oleic acid	2½ ounces	65 grams
Nitrobenzene	15 minims	1 ml.

This mixture is melted at as low a temperature as possible and stirred until thoroughly mixed. Then there is added with careful stirring and mixing while warm,

Tripoli (Finest Kieselguhr)	10 ounces	250 grams

The tripoli may be replaced by very finely powdered pumice which has been sifted through fine silk bolting cloth. Or the pumice powder may be used dry or with the following medium:

244.—ALTERNATIVE DRY REDUCER MEDIUM

Oil of turpentine	2 ounces	50 grams
Benzene or carbon tetrachloride	2 ounces	50 grams

The application of the abrasive may be made with the aid of artist's stumps, either of leather or paper, or by using a pen holder, the rounded end of which has been covered with linen or wash leather, or for very small areas chisel shaped, pear or other similar wood tools.

When the reduction is complete every trace of the abrasive material must be carefully removed with brush and alcohol or benzol.

KNIFING

This is normally a more drastic method of retouching than the use of abrasive, for it allows of the complete removal of part of the image if desired. The retouching knife must have a razor edge and the edge must be constantly renewed by the proper use of an oilstone.

Knifing is carried out by making parallel strokes one after the other until the whole area to be reduced has been covered. The process is now repeated with the direction of the strokes at a decided angle to the first set and so on. In this way if the work is carefully done the individual strokes are quite imperceptible.

With negatives which have already been reduced with

Farmer's reducer the knife sometimes takes badly; in such a case the area can be lightly rubbed down with Globe metal polish or similar very lightly abrasive pastes.

PENCIL RETOUCHING

The art of pencil retouching can easily be abused, and its excessive use has brought discredit on certain branches of photography in past times. Used with discretion, that is not for the beautification of a picture but for the correction of blemishes or errors, it can perform valuable service.

In order that the negative will take the pencil properly, it is usually necessary to treat it with a varnish. Certain portrait plates and films are actually supplied with a matt surface to facilitate retouching, but in the absence of this a matt varnish must be used.

VARNISHING

One of the most useful is the water varnish made up as follows:

245.—WATER VARNISH

Orange shellac	1½ ounces	36 grams
Borax	200 grains	10 grams
Carbonate of soda	40 grains	2 grams
Glycerine	40 minims	2 ml.
Water	16 ounces	400 ml.

The borax and soda are dissolved first in about half the water, the solution warmed and the shellac added and stirred until dissolved, which will probably require gentle heating. Then filter through clean linen and make up to the full quantity after adding the glycerine.

The negative can be bathed in this varnish and so given a matt coat, both back and front, which will easily take retouching.

Some workers prefer a warm alcohol varnish and a useful one is:

246.—ALCOHOL VARNISH

Bleached shellac (powdered)	8 ounces	200 grams
Gum sandarac	2 ounces	50 grams
Gum mastic	¼ ounce	6 grams
Gum dammar	¼ ounce	6 grams
Castor oil	5 drops	5 drops
95% alcohol	80 ounces	2000 ml.

When the shellac and the gums are completely dissolved the varnish must be filtered. Before it is used the plate must be warmed and sufficient of the varnish poured on to flow evenly over the surface to be matted, the excess being allowed to flow back into the varnish bottle from a corner of the plate.

This matt coating can be removed, if necessary, by dissolving off with alcohol.

A cold varnish can also be used, namely:

247.—COLD VARNISH

Gum dammar	¼ ounce	6 grams
Carbon tetrachloride	4 ounces	100 ml.
When dissolved add manilla copal	¼ ounce	6 grams

Solution takes some time and is best helped by heating the mixture in a water bath. The varnish should be filtered hot. Note that it is not inflammable.

Another cold varnish is prepared by taking:

248.—ALTERNATIVE COLD VARNISH

Gum sandarac	2 ounces	50 grams
Benzene	8 ounces	200 ml.
Acetone	10 ounces	250 ml.
Alcohol 95%	4 ounces	100 ml.

Solution can be aided by careful warming in a water bath and the varnish must be filtered warm. The cold varnishes can be applied to well dried negatives without their being warmed.

The cold varnishes give a somewhat thinner film than the warm varnish, but permit of an even heavier retouching being carried out.

Another type of matting is that which is applied with a wad of linen and not poured over the negative. These varnishes have the advantage that they dry very rapidly but are not particularly suitable for use on negatives which are to be enlarged.

249.—NORMAL MATTING VARNISH

Gum dammar	1 ounce	25 grams
Oil of turpentine	5 ounces	125 ml.

250.—RAPID MATTING VARNISH

Gum dammar	½ ounce	12 grams
Oil of turpentine	3 ounces	75 grams
Petrol-ether	3 ounces	75 grams
Oil of lavender	30 minims	2 grams

These two varnishes give a very thin matt coating which will only take very light retouching.

When negatives are intended for enlarging the varnish must be applied equally over the whole of the negative surface but, for contact prints only, the varnish can be applied just where retouching is required.

In addition to providing a surface which takes retouching in a satisfactory manner, these varnishes also act as a protective coating to the negative and preserve it from scratches or other change.

A simple protective varnish can be prepared from waste film which has been cleansed free from all gelatine coating and carefully dried.

251.—CELLULOID VARNISH

Celluloid	¼ ounce	6 grams
Amyl acetate	4 ounces	100 ml.
Acetone	4 ounces	100 ml.

APPLYING THE VARNISH

For good results to be obtained it is important that varnish be applied so that an even coat covers the whole of the negative. The negative is first dusted carefully with a soft brush, and a small pool of the varnish poured on to the centre of the plate. By tilting the plate carefully, first one way and then another, the varnish is caused to flow evenly over the whole surface. Finally, the plate is tilted so that the excess varnish flows back into the varnish bottle from the right lower corner.

To varnish film negative they are first fastened down to a glass plate with a suitable cement and the process then carried out as for a glass plate. Note that shellac or gum dammar varnishes may be used with films, but the celluloid varnish must not be used as it would attack the film base.

PENCILS FOR RETOUCHING

Pencils of varying hardness are used in retouching. Soft pencils give dark marking and density, while harder pencils give lighter effects. As a general rule the pencil chosen for a particular piece of work should need to go over the area 4-5 times in order to build up the necessary density. The pencil

is used to give a stippling effect on the film, and both practice and good judgment are required for success.

If, by chance, too heavy a retouch has been given, correction can be achieved by removing the blackening with benzine or turpentine and the area dealt with again.

All retouching work should be carried out on some form of retouching desk. This consists essentially of a frame (page 329), which encloses a ground glass sheet upon which the negative is laid. The frame can be set at any convenient angle and light from a window or other light source is reflected by a mirror through the ground glass screen. If artificial light is used, the mirror should be covered by a white card or sheet of paper to diffuse the light.

Processing Colour Films

Practically all modern colour films rely on the formation of dye images in three separate emulsion layers by a process of chromogenic development similar to that described on page 223. Before giving details of processing procedures for colour films it is advantageous to outline the basic principles upon which modern colour films are based.

Modern colour materials utilise the *subtractive* principle of colour reproduction which is the reproduction of colours by the formation of various amounts of *cyan*, *magenta*, and *yellow* dyes in three separate red, green and blue sensitive emulsion layers. Cyan, magenta and yellow are the *subtractive primaries* and are equivalent to minus red minus green, and minus blue respectively:

Minus red ≡ cyan (blue + green)
Minus green ≡ magenta (blue + red)
Minus blue ≡ yellow (green + red)

The diagrams on page 365 show these subtractive primaries together with the composition of white light and the *additive primaries* (red, green and blue).

The subtractive primaries are used in modern colour material because they possess the property that they can be superimposed in all possible combinations to form an infinite range of colours, whereas the additive primaries do not have this property (see page 366). Thus:

Red ≡ magenta + yellow (white minus green and minus blue)
Green ≡ cyan + yellow (white minus red and minus blue)
Blue ≡ cyan + magenta (white minus red and minus green)

Most modern colour photographic materials are in the form of an *integral tripack* (see diagram on page 367) which consists of a blue sensitive layer that records the blue portions of the original scene as a yellow image, a green sensitive layer that records the green portions of the original scene as a

magenta image, and a red sensitive layer that records the red portions of the original scene as a cyan image. Integral tripacks also contain a yellow filter layer immediately below the top blue sensitive layer to filter out blue light to which the green and red sensitive layers are also slightly sensitive. The procedure described above and illustrated on page 367 results in the formation of a colour negative, because the colours in the negative are complementary to those of the original scene. It can be worked out from the various colour equations given previously that if a colour negative is printed on to a similar tripack material coated on paper a positive print will be formed: e.g. consider the reproduction of a red: this will be recorded in the negative as a cyan (blue + green) image which on printing will expose the blue and green sensitive layers of the paper to form yellow and magenta images (minus blue and minus green, i.e. red).

Reversal processing, however leads directly to a positive transparency as shown in the diagram on page 368.

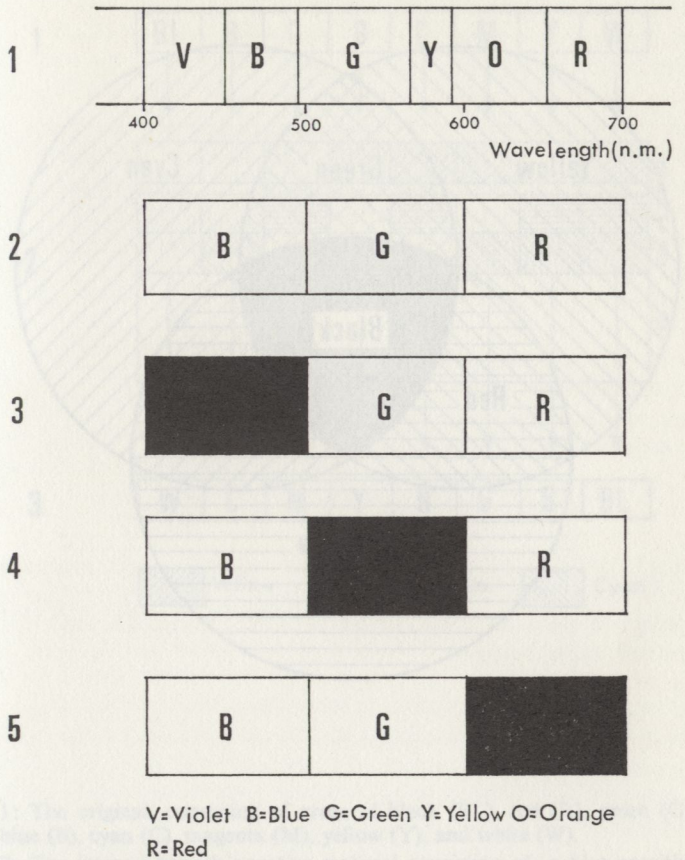
With negative colour films, the processing is comparatively simple and can be carried out with the same equipment as for black and white materials. Colour processing, however, requires much stricter control of processing conditions than black and white processing. Development temperature must be maintained within very close limits ($\pm\frac{1}{4}$°C.), pH values of the processing solutions must be kept within the specified values and development times must not be altered from those recommended by the manufacturer.

The processing of reversal colour film requires more steps leading to a positive transparency. The procedure is straightforward and can also be carried out with the same equipment as used for black-and-white material. The main points to watch are also temperatures and times, and the instructions given by the manufacturers must be carefully followed.

"OFFICIAL" AND "SUBSTITUTE" FORMULAE

Amateurs who prefer to make up their own solutions will find this a straightforward job in black-and-white photography. There is no doubt as to the choice of the formula as all manufacturers have published the most suitable formulae for their products. Besides, in nearly all cases it is possible to use universal formulae suitable for a wide range of makes of film.

WHITE LIGHT, THE ADDITIVE AND SUBTRACTIVE PRIMARIES



1: The approximate distribution of colours in the visible spectrum.

2: The visible spectrum can be divided into three equal regions of blue, green and red known as the *additive primaries*.

3-5: Subtracting each additive primary colour in turn from the visible spectrum gives the *subtractive primaries*. Thus: minus blue appears *yellow* (3), minus green appears *magenta* (4), and minus red appears *cyan* (5).